

Amendments to the Claims:

This listing of claims will replace all prior versions and listings of claims in the application:

1 1. (Currently Amended) A method for controlling a gap
2 | between in an electrically conducting features on a membrane solid-state
3 | structure, comprising the steps of:
4 providing a plurality of electrically conducting features disposed on a
5 membrane including an aperture aligned with a gap between the features;
6 exposing the features to a fabrication process environment conditions
7 of which are selected to alter an extent of the gap ;
8 applying a voltage bias across the gap during process environment
9 exposure of the features;
10 measuring electron tunneling current across the gap during process
11 environment exposure of the features to indicate an extent of the gap; and
12 controlling the process environment during process environment
13 exposure of the features, based on the tunneling current measurement, to
14 control an extent of the gap.

1 2. Canceled.

1 3. (Original) The method of claim 1 wherein controlling the
2 process environment comprises comparing tunneling current measurement
3 with a threshold tunneling current corresponding to a prespecified gap extent
4 and controlling the process environment based on the comparison.

1 4. (Previously Presented) The method of claim 1 wherein the
2 conditions of the fabrication process environment are selected to increase an
3 extent of the gap.

1 5. (Previously Presented) The method of claim 1 wherein the
2 conditions of the fabrication process environment are selected to decrease an
3 extent of the gap.

1 6. (Previously Presented) The method of claim 1 wherein the
2 fabrication process environment comprises ion beam exposure of the features.
3 .

1 7. (Previously Presented) The method of claim 6 wherein the ion
2 beam exposure comprises blanket ion beam exposure of the features.

1 8. (Currently Amended) The method of claim 6 wherein the ion
2 beam exposure comprises rastering of the features ~~structure~~ by a focused ion
3 beam.

1 9. (Previously Presented) The method of claim 1 wherein the
2 plurality of electrically conducting features on the membrane comprises two
3 electrically conducting electrodes having the gap between the electrodes.

1 10. (Currently Amended) The method of claim 9 wherein the
2 membrane comprises electrically conducting electrodes ~~are disposed on an~~
3 electrically insulating membrane including an aperture aligned with the gap
4 between the electrodes.

11. Canceled.

12. (Canceled)

13. (Canceled)

14. (Canceled)

15. (Canceled)

16. (Canceled)

17. (Canceled)

18. (Canceled)

19. (Canceled)

20. (Canceled)

21. (Canceled)

1 22. (Previously Presented) The method of claim 1 wherein the
2 fabrication process environment comprises electron beam exposure of the
3 features.

1 23. (Previously Presented) The method of claim 9 wherein each
2 electrically conducting electrode is connected in a closed-loop circuit across the
3 gap for measuring electron tunneling across the gap.

1 24. (Previously Presented) The method of claim 9 wherein each
2 electrically conducting electrode is disposed in a connection to an electrical
3 contact pad.

1 25. (Currently Amended) The method of claim 24 wherein applying
2 | a voltage bias across the gap between the electrodes in the structure comprises
3 applying a voltage bias between the electrical contact pads.

1 26. (Previously Presented) The method of claim 1 wherein providing
2 a plurality of electrically conducting features disposed on a membrane including
3 an aperture aligned with a gap between the features comprises:

4 first providing an electrically conducting feature, disposed on a membrane
5 including an aperture, without a gap; and

6 initiating the fabrication process environment to define the plurality of
7 electrically conducting features by forming a gap between the features in
8 alignment with the aperture.

1 27. (Previously Presented) The method of claim 1 wherein providing
2 a plurality of electrically conducting features disposed on a membrane including
3 an aperture aligned with a gap between the features comprises:

4 first providing an electrically conducting feature, disposed on a membrane
5 including an aperture, without a gap; and

6 initiating a fabrication process environment to provide a gap in the
7 electrically conducting feature, in alignment with the aperture, that defines two
8 electrically conducting electrodes separated from each other by the gap.

1 28. (Currently Amended) The method of claim 27 wherein the
2 | exposure of the two electrically conducting electrodes structure to fabrication
3 process environment increases the extent of the gap between the two electrically
4 conducting electrodes.

29. (Previously Presented) The method of claim 10 wherein the electrically insulating membrane comprises a silicon nitride membrane.

30. (Previously Presented) The method of claim 1 wherein the membrane is supported at its edges by a silicon substrate.

31. (Previously Presented) The method of claim 1 wherein measuring electron tunneling current comprises amplifying acquired electron tunneling current prior to measuring electron tunneling current.

32. (Previously Presented) The method of claim 1 wherein measuring electron tunneling current comprises digitizing acquired electron tunneling current prior to measuring electron tunneling current.

33. (Previously Presented) The method of claim 1 wherein applying a voltage bias across the gap comprises applying across the gap a voltage that is less than a work function that is characteristic of the electrically conducting features .

34. (Previously Presented) The method of claim 1 wherein controlling the process environment based on tunneling current measurement comprises:
 determining an extent of the gap, g , as a function of measured tunneling current, I , and applied voltage bias, V , as:

$$I(V) = aV^2e^{-b/V}$$

where
$$a = \frac{\sigma e^3}{16\pi^2 \phi \hbar g^2} \quad \text{and} \quad b = \frac{4(2m_e)^{1/2} \phi^{3/2} g}{3\hbar e}$$

and where σ is an area of each electrically conducting feature at opposite sides of the gap, e is the elementary charge, 1.6×10^{-19} C; $\hbar = 1.1 \times 10^{-34}$ J·s; $m_e = 9.1 \times 10^{-31}$ kg

1 ³¹ Kg; and ϕ is a work function of the electrically conducting features at the gap;
2 and
3 controlling the process environment based on the determined gap.

1 35. (Previously Presented) The method of claim 1 wherein controlling
2 the process environment based on tunneling current measurement comprises:
3 determining an extent of the gap, g , as a function of measured tunneling
4 current, I , and applied voltage bias, V , as:

5
$$I(V) = I_0 e^{-\alpha \sqrt{\phi} g}$$

6 where
$$I_0 = \frac{\sigma e^2}{4\pi^2 \hbar^2} \frac{\sqrt{2m_e \phi}}{g} V \quad \text{and} \quad \alpha = \frac{2\sqrt{2m_e}}{\hbar}$$

7 and where σ is an area of each electrically conducting feature at opposite sides of
8 the gap, e is the elementary charge, 1.6×10^{-19} C; $\hbar = 1.1 \times 10^{-34}$ J·s; $m_e = 9.1 \times 10^{-$
9 ³¹ Kg; and ϕ is a work function of the electrically conducting features at the gap;
10 and
11 controlling the process environment based on the determined gap.